CLAIMS

1. An apparatus comprising:

a substrate;

a driver circuit including a plurality of high-voltage thin-film transistors (HVTFTs) formed on the substrate, each HVTFT including a controlling gate electrode, a source electrode, and a drain electrodearranged such that the source electrode is separated from the controlling gate electrode by a first distance, and the drain electrode is spaced from the controlling gate electrode such that a shortest distance between any part of the drain electrode and the controlling gate electrode is significantly larger than the first distance, and such that a first break down voltage between the drain electrode and the source electrode is larger than a second break down voltage between the controlling gate electrode and the source electrode; and

a plurality of actuated MEMS devices formed on the substrate, wherein each of the actuated MEMS device is connected to the drain electrode of an associated HVTFT of the plurality of HVTFTs.

2. The apparatus according to Claim 1,

wherein the drain electrode of each said associated HVTFT is connected to an actuating voltage source, and each the source electrode of each said associated HVTFT is connected to a low voltage source,

wherein driver circuit includes means for selectively generating a control signal on the controlling gate electrode of each said associated HVTFT such that when the control signal is maintained at a selected control voltage level, said associated HVTFT is fully turned on to couple the drain electrode to the low voltage source, and

wherein the selected control voltage level is substantially lower than an actuating voltage supplied by the actuating voltage source to the source electrode of the associated HVTFT.

3. The apparatus according to Claim 1, wherein each of the actuated MEMS devices comprises:

an actuating electrode formed on a dielectric layer; and

a MEMS structure including an anchor portion rigidly attached to the substrate, and a movable portion extending from the anchor portion and located adjacent to the actuating electrode,

wherein the MEMS structure is fabricated with an internal stress gradient such that the movable portion bends into a first position relative to the substrate when the electrode generates a first electrostatic field, and the movable portion bends into a second position relative to the substrate when the electrode generates a second electrostatic field.

4. The apparatus according to Claim 1, wherein the substrate comprises one of glass, ceramic, plastic, stainless steel, a flexible substrate, and a semiconductor material.

5. The apparatus according to Claim 1, wherein the substrate comprises an active integrated circuit including a logic control circuit coupled to the controlling gate electrode of the HVTFT.

6. The apparatus according to Claim 1, wherein the driver circuit comprises:

a first HVTFT having a first controlling gate electrode and a source electrode connected to an actuating voltage source, and a first drain electrode connected to an intermediate node;

a second HVTFT having a second drain electrode connected to the intermediate node, a second source electrode connected to a low voltage source, and a second controlling gate electrode; and

means for selectively generating a maximum control voltage on the second controlling gate electrode, whereby the second HVTFT is turned on to couple the second drain to the low voltage source,

wherein the maximum control voltage is substantially lower than an actuating voltage supplied by the actuating voltage source to the first source electrode.

7. The apparatus according to Claim 6, wherein an associated actuated MEMS device of the plurality of MEMS devices comprises:

an actuating electrode formed on a dielectric layer and connected to the intermediate node; and

a MEMS structure including an anchor portion rigidly attached to the substrate, and a movable portion extending from the anchor portion and located adjacent to the actuating electrode,

wherein the MEMS structure includes an internal stress gradient formed such that the movable portion bends away from the actuating electrode when the maximum control voltage is applied to the second controlling gate electrode.

8. The apparatus according to Claim 1,

wherein an associated actuated MEMS device of the plurality of MEMS devices comprises:

an actuating electrode formed on a dielectric layer, and

a MEMS structure including a movable portion located adjacent to the actuating electrode; and

wherein the driver circuit comprises:

an alternating-current (AC) voltage supply for generating a high voltage AC signal on one of the electrode and the movable portion of the associated MEMS device,

an associated HVTFT having a drain electrode connected to the other of the electrode and movable portion of the MEMS structure, a source electrode coupled to a low voltage source, and a controlling gate electrode, and

means for selectively generating a maximum control voltage on the controlling gate electrode of the associated HVTFT, whereby the associated HVTFT is turned on to couple the second drain to the low voltage source,

wherein the maximum control voltage is substantially lower than an amplitude of the high voltage AC signal.

9. The apparatus according to Claim 8, further comprising:

a first capacitor connected between the source electrode of the associated HVTFT and the low voltage source; and

a second capacitor connected between the controlling gate electrode of the associated HVTFT and the low voltage source.

10. An apparatus comprising:

a substrate;

an actuated MEMS device including:

an actuating electrode formed over the substrate; and

a MEMS structure including a movable portion located adjacent to the actuating electrode,

wherein the MEMS structure is formed such that the movable portion is actuated into a first position relative to the substrate when the electrode generates a first electrostatic field, and the movable portion is actuated into a second position relative to the substrate when the electrode generates a second electrostatic field; and

an actuating circuit mounted on the substrate for selectively applying one of a first actuating voltage to the actuated MEMS device, whereby the actuating electrode generates the first electrostatic field, and a second actuating voltage to the actuating electrode, whereby the actuating electrode generates the second electrostatic field,

wherein the actuating circuit includes a high-voltage thin-film transistor (HVTFT) formed on the substrate, the HVTFT including a controlling gate electrode, a source electrode, and a drain electrode arranged such that a portion of the source electrode is separated from the controlling gate electrode by a first distance, and the drain electrode is arranged in an offset position such that the drain electrode is laterally offset from the controlling gate electrode by an offset distance that is substantially greater than the first distance.

11. The apparatus according to Claim 10, wherein the substrate comprises one of glass, ceramic, plastic, stainless steel, a flexible substrate, and a semiconductor material.

12. The apparatus according to Claim 10, wherein the substrate comprises an active integrated circuit including a logic control circuit coupled to the controlling gate electrode of the HVTFT.

13. The apparatus according to Claim 10, wherein the drain electrode of the HVTFT is connected to the actuating electrode of the actuated MEMS device, and the source electrode of the HVTFT is connected to a low voltage source.

14. The apparatus according to Claim 10, wherein the drain electrode of the HVTFT is connected to one of the anchor portion

and the actuating electrode of the actuated MEMS device, and the source electrode of the HVTFT is connected to a low voltage source.

15. An apparatus comprising:

a control logic circuit for generating control signals having a maximum logic voltage;

a low voltage source;

a high voltage source for providing an actuating voltage that is substantially higher than the maximum logic voltage;

a first high voltage thin-film transistor (HVTFT) including a controlling gate electrode coupled to the control circuit, a source electrode positioned relatively close to the controlling gate electrode and coupled to the low voltage source, and a drain electrode positioned relatively far from the controlling gate electrode and coupled to the high voltage source; and

an actuated MEMS device connected to the drain electrode of the first HVTFT.

16. The apparatus according to Claim 15, further comprising a second HVTFT having a first controlling gate electrode and a source electrode connected to the high voltage source, and a first drain electrode connected to an intermediate node,

wherein the drain electrode of the first HVTFT is connected to the intermediate node.

17. The apparatus according to Claim 16, wherein the actuated MEMS device comprises:

an actuating electrode connected to the intermediate node; and

a MEMS structure including an anchor portion, and a movable portion extending from the anchor portion and located adjacent to

the actuating electrode,

wherein the MEMS structure includes an internal stress gradient formed such that the movable portion bends away from the actuating electrode when the maximum control voltage is applied to the second controlling gate electrode.

18. The apparatus according to Claim 15, wherein the actuated MEMS device comprises:

an actuating electrode, and

a MEMS structure including a movable portion located adjacent to the actuating electrode,

wherein the apparatus further comprises an alternating-current (AC) voltage supply for generating a high voltage AC signal on one of the movable portion and the actuating electrode of the actuated MEMS device, and

wherein the drain electrode of the first HVTFT is connected to the other of the movable portion and the actuating electrode of the actuated MEMS device, and the source electrode of the first HVTFT is coupled to a low voltage source.

19. The apparatus according to Claim 18, further comprising:

a first capacitor connected between the source electrode of the first HVTFT and the low voltage source; and

a second capacitor connected between the controlling gate electrode of the first HVTFT and the low voltage source.

20. The apparatus according to Claim 15, wherein control logic circuit, the first HVTFT, and the actuated MEMS device are integrally formed on a substrate comprising one of glass, ceramic, plastic, stainless steel, a flexible substrate, and a semiconductor material.